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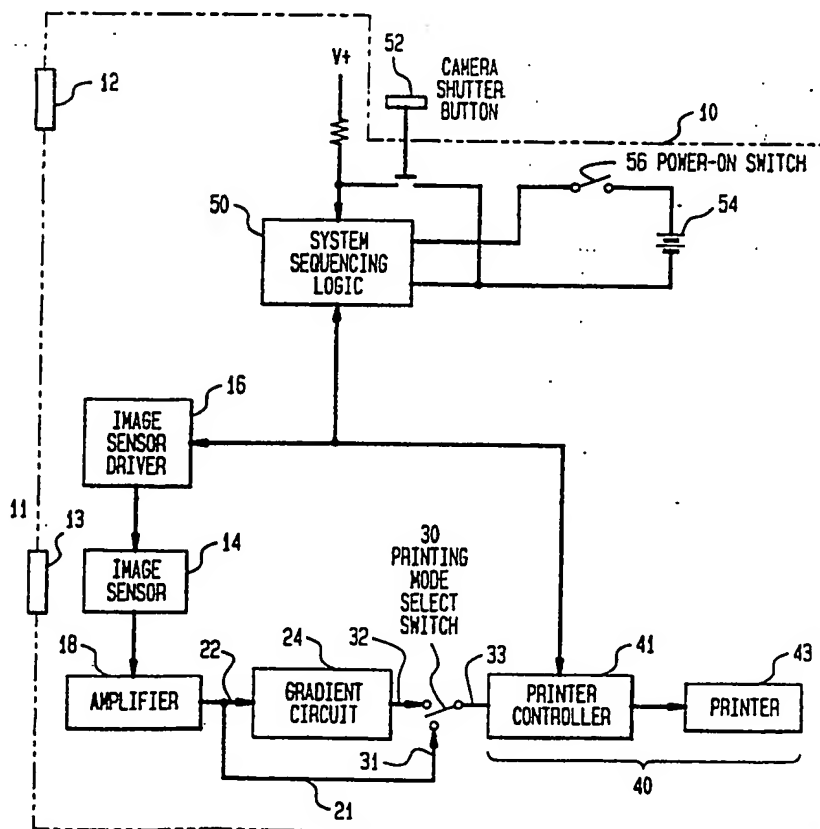
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(54) Title: MEMORYLESS ELECTRONIC CAMERA WITH DIRECT HARD COPY OUTPUT

(57) Abstract

A compact photo-imaging and print-out device is configured in the form of a quasi toy camera capable of being operated by a child and is exclusive of image storage memory and any attendant supervisory microprocessor. Instead, the electronic response of an image capture ccd array is coupled directly to a print-out unit, either "as is" or via a selectively inserted gradient circuit. In the former instance, a captured image is printed out by the printer in accordance with its grey scale content; in the latter instance, the printer will generate an outline or line drawing of the captured image based upon prescribed differences in contrast of the captured image.



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**MEMORY-LESS ELECTRONIC CAMERA
WITH DIRECT HARD COPY OUTPUT**

FIELD OF THE INVENTION

5 The present invention relates in general to photographic apparatus and is particularly directed to a simplified, compact electronic camera that can be operated by a child and which provides a direct hard copy print out of a captured image.

10

BACKGROUND OF THE INVENTION

 Improvements in size, robustness and cost of electronic imaging components, such as charge-coupled imagers and compact print devices, have made it
15 possible to reduce the hardware complexity of imaging and recording systems. Typically, however, such systems employ a resident image memory and associated microprocessor attendant to the storage of the image and the execution of a variety of control functions and
20 applications, so that the cost of such systems must reflect the cost of these additional control components and firmware.

SUMMARY OF THE INVENTION

25 In accordance with the present invention, advantage is taken of the ability to house and integrate miniaturized imaging and printing units together as a compact unit, but without the additional cost and sophistication that results from the use of an
30 image memory and an adjunct microprocessor. Specifically, the present invention is directed to a compact photo-imaging and printout device, which is configured in the form of a quasi toy camera capable of being operated by a child. Pursuant to the
35 invention, rather than provide an image memory in which the captured image is stored for subsequent processing

via control firmware that drives an attendant supervisory microprocessor, the electronic response of the image capture unit is coupled directly to the print-out unit, either 'as is' or via a selectively
5 inserted contrast discriminator or gradient circuit. In the former instance, a captured image is printed out by the printer in accordance with its grey scale content; in the latter instance the printer will generate an outline or line drawing of the captured image based
10 upon prescribed differences in contrast of the captured image.

In accordance with a preferred embodiment of the invention, the image capture unit comprises a charge coupled image sensor array. The contents of the
15 respective imaging cells of the sensor array, rather than being written into an image memory and then subsequently accessed for read-out by a separate control processor, are read out through analog signal processing circuitry to a compact printer, so that the
20 user (e.g. child) is immediately presented with a hard copy or picture of the scene of interest. Depending upon the setting of an external switch, preset by the user, the output of the sensor array will be amplified and coupled directly to the printer as a full grey
25 scale image, or will be amplified and passed to the printer through a contrast filter as a contrast-representative image. The contrast filter is implemented as an analog gradient circuit, which generates a pulse when those contents of the captured
30 image signals meet a prescribed change in contrast, so that what the printer receives are signals representative of borders or outlines of the captured scene. This latter capability enables the printer to provide a hard copy image similar to that found in a
35 child's coloring book, so that the child may color or otherwise fill in the printed image.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 diagrammatically shows a compact camera in accordance with a preferred embodiment of the present invention;

5 Figure 2 shows the circuit configuration of a gradient circuit;

Figure 3 is a timing diagram for illustrating the operation of the gradient circuit of Figure 2. and

10 Figures 4 and 5 respectively illustrate the two modes of operation of the printer.

DETAILED DESCRIPTION

Before describing in detail the particular improved compact camera in accordance with the present invention, it should be observed that the present
15 invention resides primarily in a novel structural combination of conventional camera optics, reproduction components and imagery signal processing circuits, rather than in the particular detailed configurations thereof. Accordingly, the structure, control and
20 arrangement of these conventional optics, circuits and components have been illustrated in the drawings by readily understandable block diagrams which show only those specific details that are pertinent to the present invention, so as not to obscure the disclosure
25 with structural details which will be readily apparent to those skilled in the art having the benefit of the description herein. Thus, the block diagram illustrations of the Figures do not necessarily represent the mechanical structural arrangement of the
30 exemplary system, but are primarily intended to illustrate the major elements of the system in a convenient functional grouping, whereby the present invention may be more readily understood.

Referring now to Figure 1, a compact camera
35 in accordance with a preferred embodiment of the present invention is diagrammatically shown as

comprising a hand-held housing 10 in which all of the components of the camera are integrated as a unitary image capture and reproduction system, as will be described below. Since a description of the configuration of the camera housing, per se, is unnecessary for gaining an understanding of the present invention, no further description of the same will be presented here. As in a conventional camera the system includes an imaging lens 11 which projects an image of a scene, observed through a viewfinder 12, onto an image plane 13. Coincident with image plane 13 is electronic image sensor array 14, having an associated image sensor driver 16. Array 14 and its associated driver 16 are preferably commercially available components and may comprise an integrated unit, such as a KAI-0280 ccd imager, manufactured by Eastman Kodak.

The output of the image sensor array 14 is coupled through an amplifier 18 to a pair of parallel signal processing paths 21 and 22. Signal coupling path 21 is connected to a first input 31 of a print mode selector switch 30. The output 33 of selector switch 30 is coupled to the input of an image print unit 40 (comprised for example of a Ricoh MCBO compact copier), containing a print controller 41 and a printer 43 driven thereby. Signal coupling path 22, on the other hand, is connected to a gradient circuit 24, the output of which is coupled to a second input 32 of print mode selector switch 30. Gradient circuit 24, the details of which will be described below with reference to Figure 2, operates as a contrast filter, passing only those contents of the captured image signals which are associated with a prescribed change in contrast. Consequently, when print mode switch couples input 32 to output 33, what the printer 43 receives are signals representative of borders or outlines of the captured scene. As noted earlier, this 'border only' capability

enables the printer to provide a hard copy image similar to that found in a child's coloring book.

Control of the operation of the components of the camera is effected by way of a system sequencing logic circuit 50, containing an internal clock generator, combinational logic and flip-flop circuits and is preferably implemented in the form of programmable array logic components. As such, system sequencing logic circuit 50 effectively performs clock source and state machine functions, cycling through the operation of sensor array 14 and printer unit 40 in response to the activation (depression) of a camera shutter button 52. Rather than describe the gate-to-gate details of the logic circuitry contained in system sequencing logic circuit 50, the discussion set forth below will detail the sequence of operations of the image sensor array and the printer to which the image signals generated by the sensor array are coupled in the course of the generation of a hard copy print.

Camera shutter button 52 is coupled in a conventional manner with a power source (battery unit) 54 and power on switch 56. When depressed, camera shutter button 52 initiates an image capture and print sequence. Specifically, the sequence begins with controller enabling array driver 16 which, in turn, causes imaging array 14 to capture whatever image is currently projected through lens 11 onto the array. When image array 14 is scanned, the captured image-representative contents of the successive cells or sequentially rows of the image array 14 are successively sampled and read out through output amplifier 18 to each of parallel video signal paths 21 and 22. Depending upon the setting of print mode switch 30, the continuous grey scale video samples output by array 14 are coupled, as is, or through gradient circuit 24 to print unit 40. Print controller 41 is

supplied with the clocking signals from system sequence logic circuit 50 that drive the imaging array, so as to synchronize the print out with the scanning of the successive rows of the image array.

5 Referring now to Figure 2, a schematic circuit diagram of gradient circuit 24 is shown as including operational amplifier 18 to which the output of CCD image signal is coupled. The output of amplifier 18 is coupled to first and second signal paths 61 and 10 62, respectively coupled to the source-drain paths of selectively enabled FETs 64 and 66, the outputs of which are coupled to respective clamp and sampling storage capacitors 71, 72 and to opposite polarity inputs of a differential amplifier 75. Sampling storage 15 capacitor 72 is further coupled to the source-drain path of a selectively enabled FET 76, the output of which is coupled to one end of resistor 81 of a voltage divider 80 comprised of resistors 81, 82. The other end of resistor 81 is coupled to a first polarity input of 20 a Schmitt trigger 90 and to one end of resistor 82, the second end of which is coupled to the output of Schmitt trigger 90. A second polarity input of Schmitt trigger 90 is coupled to the output of differential amplifier 75. The output of Schmitt trigger 90 is coupled to 25 input 32 of print mode selector switch 30.

The operation of gradient circuit 24 may be understood with reference to Figure 3, which contains a timing diagram showing the relationship of video input signals derived from ccd sensor array 14, enable 30 signals referenced to a system clock, and the output of the gradient circuit 24. Signal trace 100 corresponds to the video output derived from a row of charge coupled devices within array 14. Clamp clock CLK turns on FET 64 during the reset interval so that capacitor 35 71 stores a reference or clamp value associated with the reset interval 101 of a ccd cell against which

changes in the response of the ccd cells are measured. Similarly, strobe signal STB samples the magnitude of image-representative component 102 of the ccd signal 100 following the reset interval 101, so that capacitor 5 72 stores the magnitude of the actually sampled image signal. Differential amplifier 75 outputs the difference between these successive values to one input of Schmitt trigger 90. The second input of Schmitt trigger 90 is referenced to a prescribed fraction of 10 the magnitude of the previously sample image signal, as coupled through FET 76 during the clamp interval. The prescribed fraction which is employed as a trigger reference or threshold for Schmitt trigger 90 is established by the settings of resistors 81 and 82 of 15 voltage divider network 80.

As shown in Figure 3, during the first two sampling intervals 111 and 112 (corresponding to the sampling of successive ccd cells of a given row of the array 14), the magnitude of the ccd output remains 20 unchanged (at a minimum value). However, for the next successive sampling interval 113, its associated ccd cell shows a marked change in response DV1, which exceeds the threshold for Schmitt trigger 90. Consequently, Schmitt trigger 90 generates an output 25 pulse 120 indicative of a marked contrast between the light falling on the previously sampled ccd cell and the currently sampled cell. The image signal outputs of further cells (samples 114, 115, 116, 117) successively adjacent to the cell producing sample 113 show a 30 gradual change in grey level, but not a change between any two immediately successive samples sufficient to exceed the threshold of Schmitt trigger 90. It is to be observed by coupling its reference input to FET 76, Schmitt trigger 90 employs a dynamic reference based 35 upon the most recently sampled ccd cell in a particular row. As a result, only sharp changes in contrast (as

defined by voltage divider 80) in the image response values of adjacent cells will identify of a line in the image, so that gradient circuit 24 effectively extracts only outlines within the captured image.

5 Figures 4 and 5 respectively illustrate the two modes of operation of the printer. Figure 4 shows a full grey scale image resulting from the outputs of the ccd cells of image array 14 being amplified and coupled directly to print unit 40. Figure 5 shows a line or
10 border image resulting from the contrast filtering operation of gradient circuit 24 on the same image.

As will be appreciated from the foregoing description, the compact photo-imaging and print-out camera system of the present invention, by making
15 efficient use of commercially available miniaturized imaging and print components, without image memory and microprocessor elements, is able to provide a relatively inexpensive, quasi toy camera that a child can operate and obtain a hard copy print of a captured
20 image. Through the use of a selectively switched gradient circuit in the image signal flow path from the imaging array to the printer, the user is able to obtain a hard copy of the image 'as is' in continuous grey scale, or as an outline or line drawing similar to
25 that found in a child's coloring book.

While I have shown and described an embodiment in accordance with the present invention, it is to be understood that the same is not limited thereto but is susceptible to numerous changes and
30 modifications as known to a person skilled in the art, and I therefore do not wish to be limited to the details shown and described herein but intend to cover all such changes and modifications as are obvious to one of ordinary skill in the art.

WHAT IS CLAIMED

1. A photography apparatus comprising:
an array of controllably enabled
photoresponsive elements;
5 an actuator which controllably enables said
array of photoresponsive elements to capture electrical
information representative of an image incident
thereon;
a printer; and
10 a read out controller coupled to said array,
which controllably reads out to said printer image-
representative information from said array and supplies
said read out image-representative information to said
printer exclusive of an image storage device.
- 15 2. A photography apparatus according to
claim 1, further including an image outline extractor
which selectively causes said printer to print an
outline of said image.
3. A photography apparatus according to
20 claim 2, wherein said image outline extractor comprises
a selectively enabled image signal filter, coupled
between said array and said printer, which couples to
said printer either image-representative electrical
information as captured by said array or signals
25 representative of those portions of said captured image
which are associated with a prescribed change in a
characteristic of said image.
4. A photography apparatus according to
claim 3, wherein, in an image outline print mode, said
30 image signal filter couples to said printer signals
representative of a prescribed change in the level of
image-representative information captured by said
array.
5. A photography apparatus according to
35 claim 1, further including an image contrast
discriminator which selectively causes said printer to

print only those portions of a captured image which exceed a prescribed change in contrast with respect to adjacent portions of the image.

5 6. A compact electronic photography apparatus comprising:

 a hand-held housing;

 an array of charge coupled devices contained within said housing and controllably enabled to capture electrical information representative of an image
10 incident thereon and controllably enabled to read out said captured electrical information;

 an image capture and read-out actuator contained within said housing and operative to cause said array to capture said electrical information and
15 to read out said captured electrical information; and

 a compact printer contained within said housing, said printer being coupled to said array exclusive of image storage memory and operative to print a reproduction of said image in accordance with
20 electrical information read out from said array by the operation of said image capture and read-out actuator.

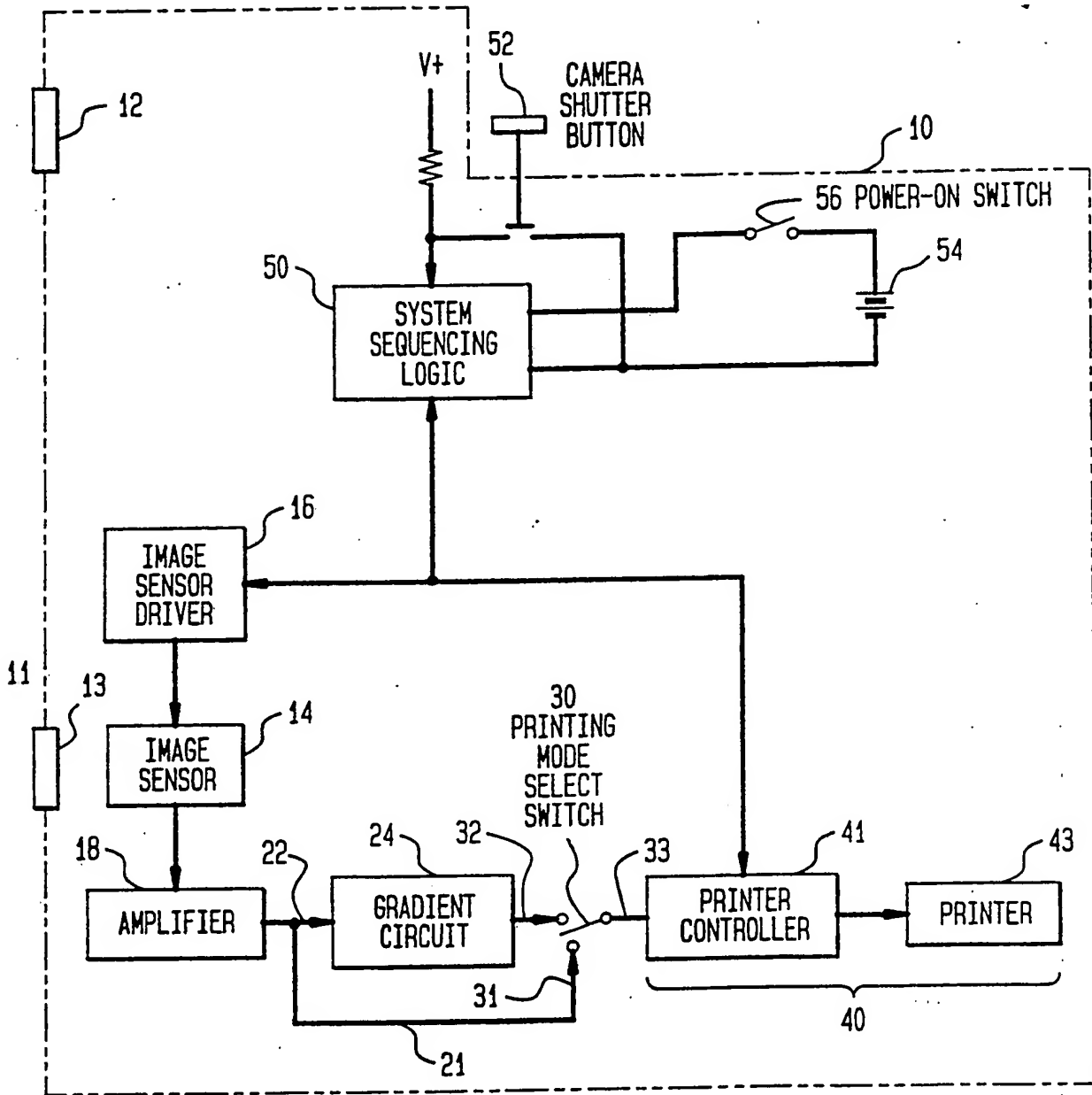
 7. A photography apparatus according to claim 6, further including an image outline extractor coupled in circuit between said array and said printer
25 and selectively enabled to cause said printer to print an outline of said image.

 8. A photography apparatus according to claim 7, wherein said image outline extractor comprises a selectively enabled image signal filter, coupled
30 between said array and said printer, which couples to said printer either image-representative electrical information as captured by said array or signals representative of those portions of said captured image which are associated with a prescribed change in a
35 characteristic of said image.

9. A photography apparatus according to claim 8, wherein, in an image outline print mode, said image signal filter couples to said printer signals representative of a prescribed change in the level of
5 image-representative information captured by said array.

10. A photography apparatus according to claim 6, further including an image contrast discriminator which selectively causes said printer to
10 print only those portions of a captured image which exceed a prescribed change in contrast with respect to adjacent portions of the image.

FIG. 1



[illegible]

The timing diagram shows the relationship between the video input and control signals. The top trace, labeled "VIDEO IN", shows a series of pulses. The first two pulses are labeled 101 and 102, with a constant level indicated by a bracket and the word "CONSTANT". The subsequent pulses are labeled 100, 101, 102, 103, 104, 105, 106, 107, and 108. The time intervals between the leading edges of these pulses are marked as Δt . The voltage levels of the pulses are marked as ΔV_1 , ΔV_2 , ΔV_3 , ΔV_4 , and ΔV_5 . Below the video input trace, there are three control signals: ϕ_{CLK} , ϕ_{STB} , and V_{OUT} . ϕ_{CLK} is a periodic square wave. ϕ_{STB} is a square wave that is high during the first two pulses of each video frame and low during the rest of the frame. V_{OUT} is a square wave that is high during the first two pulses of each video frame and low during the rest of the frame. The video input trace is divided into seven segments labeled 111 through 117, which correspond to the control signals.



FIG. 4

**FIG. 5**